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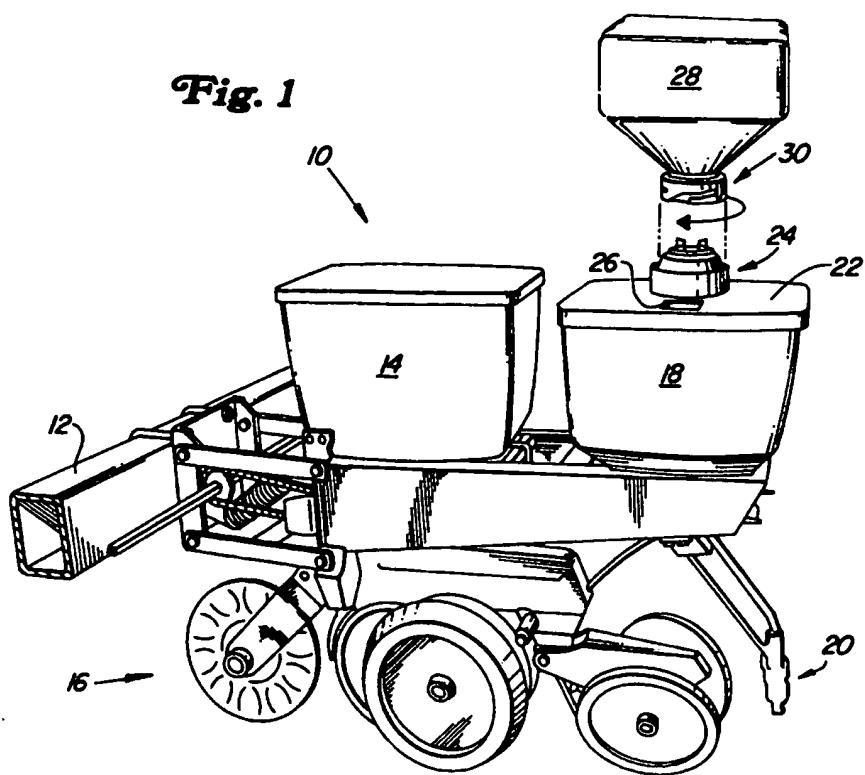
(54) Agricultural unit.

(57) An agricultural unit (10) has a frame and a chemical hopper (18) mounted to the frame for holding chemicals to be applied during an agricultural operation, whereby the chemical hopper (18) has a lid (22) for enclosing the hopper (10). Application means (20) are mounted to the frame for applying the chemicals during an agricultural operation. A chemical metering valve is operatively associated with the chemical hopper (18) and the application

means (20) for controlling the flow of chemicals from the chemical hopper (18) to the application means (20). A receiving valve (24) is mounted to the lid (22) of the hopper (18) for receiving the chemicals from a chemical package (28) and the receiving valve (24) is biased closed and adapted to receive a cooperating dispensing valve (30) on the chemical package (28).

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**Fig. 1**



The present invention relates to an agricultural unit comprising a frame, a chemical hopper mounted to the frame for holding chemicals to be applied during an agricultural operation, a lid for enclosing the hopper and application means mounted to the frame for applying the chemicals during an agricultural operation.

Agricultural planters are used for planting seeds in a field. Typical seeds are stored in a hopper and are dispensed from the hopper by a seed meter. To minimize the number of passes a farmer is required to make, a planter is usually provided with additional hoppers for holding fertilizer or granular chemical pesticides. These hoppers have chemical meters for controlling the flow of fertilizer and pesticide onto the field.

Some planters having a plurality of planting units are provided with a cross auger for directing granular fertilizer from a side loading point to individual hoppers. Liquid fertilizers have also been directed to individual tanks on a planter. In the liquid fertilizer system, as disclosed in US-A-4 244 522, liquid fertilizer in a mobile tanker is pumped through a hose to a manifold located on the planter. The hose is coupled to the planter at a coupling valve.

In many instances it is desirable for agricultural workers not to handle directly certain agricultural treatment agents, such as herbicides, insecticides or fertilizers. These agricultural treatment agents are typically delivered to the agricultural workers in sealed containers which must be opened to direct the chemicals to the hopper located on the planter.

To minimize exposure to these chemicals, it is frequently recommended for agricultural workers to wear various items of protective clothing, such as rubber gloves and respirators, when loading the planter with these chemicals. After a planting operation, some of the chemical packages may still contain unused chemicals. The empty packages and the remaining chemicals must be stored or disposed of in an approved manner.

Typical valve systems for controlling the feed of a product from a container are disclosed in the following United States patents: 4 489 858, 4 164 307, 3 543 814, 3 446 403, 3 296 649, 3 187 965, 2 975 465, 2 210 206, 2 182 878, 1 934 197, and 1,257,910. The devices disclosed in the above identified patents illustrate container valve assemblies mounted at the discharge openings of their respective containers for controlling the discharge of diverse materials such as powders, powdered soap, cleaning fluid, cosmetics, shoepolish, milk, coffee, and toner for copying machines. US-A-2 182 878 is of particular interest in that it discloses a portable container and valve system for manually applying granular agricultural materials, such as fertilizers, in a home gardening procedure.

5 EP-A1-0 199 926 which is considered in the opening paragraph discloses a pesticide hopper mounted on the back of a planting unit. The pesticide hopper is capable of containing an insecticide and is provided with conventional apparatus for dispensing controlled amounts of insecticide where desired in conjunction with planting of seeds by the planting unit.

10 None of the devices disclosed in the above identified documents are directed to a safe handling system for large scale application of commercial quantities of granular agricultural treatment material from a container.

15 According to the present invention a chemical metering valve is operatively associated with the chemical hopper and the application means for controlling the flow of chemicals from the chemical hopper to the application means and a receiving valve is mounted to the lid of the hopper for receiving the chemicals from a chemical package whereby the receiving valve is biased closed and adapted to receive a cooperating dispensing valve on the chemical package.

20 Thus a closed handling system for a chemical product is provided which comprises two valves, a dispensing valve and a receiving valve, both of which are spring biased into a closed position. The dispensing valve is adapted to interact with the complimentary receiving valve on the hopper to assure that the product will not flow from the package until the package is properly mounted to the hopper. Farmers can easily retrofit existing planters.

25 It is also proposed that the receiving valve comprises a stationary valve disc and a slidable sleeve having a valve seat which contacts the disc, the receiving valve is opened by sliding the slidable sleeve away from the valve disc when the dispensing valve is coupled to the receiving valve.

30 In addition the stationary valve disc can be mounted to a tower that projects upwardly from the hopper, the tower being located inside the slidable sleeve and defining passages through which a chemical can flow.

35 40 45 50 It would furthermore be advantageous that the receiving valve is provided with a conical portion and the sliding sleeve is provided with a conical baffle that overlies the conical portion whereby a spring is positioned between the conical portion and the conical baffle for biasing the slidable sleeve upwardly into contact with the stationary valve disc.

An embodiment of the invention will now be described with reference to the accompanying diagrammatic drawings in which:

55 Figure 1 is a perspective view of an agricultural planter having a closed granular chemical han-

Figure 2 dling system;  
is a cross sectional view of dispensing and receiving valves of the system;

Figures 3 - 5 are cross sectional views of the valve coupling and opening sequence;

Figure 6 is a bottom view of the dispensing valve taken along line 6-6 of Figure 2;

Figure 7 is a flat view of circular camming grooves of the dispensing valve;

Figure 8 is a top view of the receiving valve taken along line 8-8 of Figure 2;

Figure 9 is an exploded view of the receiving valve; and

Figure 10 is an exploded view of the dispensing valve.

Figure 1 is a perspective view of a single planting unit 10 mounted on toolbar 12. The planting unit can be of a conventional configuration and as such will only briefly be discussed. The planting unit is provided with a seed hopper 14 which is coupled to a seed meter (not shown) which directs seed to planting assembly 16. The planting assembly forms a furrow into which the seed is inserted and then closes the furrow.

The planting unit is also provided with a granular chemical hopper 18 having a granular chemical meter (not shown) for dispensing granular chemicals to chemical applicator 20. The chemical meter can be of any conventional configuration, such as the one illustrated in US-A-4 582 229, and which is incorporated herein by reference. Lid 22 of the chemical hopper 18 is provided with a receiving valve 24. In addition, the lid is provided with window 26 for viewing the contents of the hopper.

The chemical material typically loaded into the chemical hopper includes pesticides (e.g., insecticides, herbicides and fungicides) which can be applied as granules. The granular material is normally composed of a pesticide and a carrier which is (a) sorptive such as clays, (b) non-sorptive such as sand and limestone, or (c) resin particulates or beads such as polyvinyl chloride particles.

To add chemicals to the hopper a granular chemical package 28 having dispensing valve 30 is coupled to the receiving valve 24. The dispensing valve is coupled to the receiving valve by applying the dispensing valve to the receiving valve in a twisting clockwise motion. Although in the present embodiment a chemical package is coupled directly to a hopper, the chemical package could also be directly coupled to a receiving valve located immediately upstream from the chemical meter. In such a configuration, the chemical pack-

age itself would form the chemical hopper for the planter. However, by providing the receiving valve on the lid of the hopper the present closed handling system is more easily retrofitted onto existing planters.

This system can also be used for loading seed onto the planter. Chemicals may be directly applied to seed. In such applications, the seed could be added to the seed hopper using the present closed granular chemical handling system. When used in a seed application, the seed meter forms the metering valve and the planting assembly the application means.

The internal structure of the receiving valve and dispensing valve are best illustrated in Figures 2-5. The receiving valve is coupled to planter lid 22. The receiving valve comprises a stationary valve disc 32 that is mounted on tower 34. The tower comprises a cross shaped member which defines four passages through which granular chemical material can flow to the hopper. The receiving valve further comprises slidable sleeve 36 having conical baffle 38. The sleeve is provided with valve seat 40 which cooperates with stationary disc 32 to close the receiving valve. Biasing spring 42 is positioned between conical portion 44 and the underside of baffle 38 for driving the valve seat into contact with the stationary disc. The biasing spring is supported on landings 45 formed on the conical portion. Dust seal 47 is located between slidable sleeve 36 and conical portion 44. The dust seal is in wiping contact with the slidable sleeve to prevent dust and chemical granules from escaping from the hopper. The slidable sleeve has legs 46 that extend beneath the cross shaped members of the tower and are joined together by ring 48. The top of the stationary disc is provided with upwardly extending projections 49 which will be discussed in more detail below.

The receiving valve is also provided with outer cup 50 having upstanding walls 52 that are provided with inwardly projecting lugs 54. The outer cup is used for coupling the dispensing valve to the receiving valve. The outer cup telescopically receives inner cup 56 of the dispensing valve. The inner cup of the dispensing valve is provided with camming grooves 58, better illustrated in Figure 7, which engages the lugs 54 for driving the dispensing valve downwardly towards the receiving valve.

Dispensing valve 30 is mounted on the dispensing nozzle of chemical package 28 by connector elements 59 which engage slots 61 formed in the dispensing valve. The dispensing valve forms the dispensing assembly for the package. The dispensing valve comprises housing 60 having passage 62. Slidable valve member 64 having tubular skirt 65 is located inside the housing. Valve member 64 is biased downwardly by spring 66 so that

edge 67 of skirt 65 comes into contact with first valve seat 68. Valve seat 68 is inwardly canted to provide a sealing surface for outwardly canted edge 67. It has been found that it is desirable that edge 67 be a sharp edge so that it can cut through trapped granules when the valves are rotated through the neutral cam groove position. The top of the valve member is provided with guide 70 which cooperates with guide aperture 72 formed in housing 60 for guiding the vertical movement of the sliding valve member. Housing 60 forms an air pocket above valve member 64 so that granular chemicals do not compact above member 64 preventing its opening.

As illustrated in Figure 3, when the dispensing valve is initially coupled to the receiving valve, receiving valve seat 40 engages a second valve seat 74 located beneath first valve seat 68 of the dispensing valve. When receiving valve seat 40 engages second valve seat 74 it forms a closed conduit for granular chemical material flowing from the dispensing valve to the receiving valve. Second valve seat 74 is provided with an overlapping lip 75, that shingles over receiving valve seat 40 to prevent chemical granules from lodging in the valve interface.

Dispensing valve 30 is provided with downwardly extending projections 76 which cooperate with upwardly extending projections 49 of receiving valve 24 to provide a locking means for preventing the rotation of valve member 64. This provides for a wiping action between valve member 64 and first dispensing valve seat 68 when dispensing valve 30 is being removed from receiving valve 24.

In removing the package from the planter, dispensing valve 30 is rotated anti-clockwise relative to receiving valve 24. Cooperating projections 49 and 76 lock valve member 64 to the stationary disc 32 thereby causing relative rotation between first dispensing valve seat 68 and valve member 64. This wiping action aids in closing dispensing valve 30 by wiping trapped granules from between valve member 64 and valve seat 68. Stationary disc 32 wipes granules away from annular edge 77 of the dispensing valve and valve seat 40 of the receiving valve when it descends into a closed position.

Camming groove 58 of dispensing valve 30 is best illustrated in Figure 7. The camming groove has three distinct portions: introduction portion 80, neutral portion 82 and opening portion 84. Introduction portion 80 is that portion where the lugs are introduced into the groove. During the introduction portion of the camming sequence, lug 54 enters introduction portion 80, as illustrated in Figure 3. Ramp 81 of introduction portion 80 drives dispensing valve 30 downwardly against receiving valve 24. This downward movement initially opens receiving valve 24 and joins valve seat 40 to second

dispensing valve seat 74, as illustrated in Figure 4. Neutral portion 82 of the camming groove is substantially level. The neutral portion maintains the Figure 4 configuration, that is the receiving valve is open and the dispensing valve is closed. In the neutral portion of the camming groove the dispensing valve is rotated approximately 69 degrees from the end of introduction portion 80 to the beginning of opening portion 84. This provides a delay means in which the granular material has time to fall through the valve structures during the removal operation. In addition, this delay increases the duration of the wiping action of valve member 64 and stationary disc 32. Opening portion 84 is provided with ramp 85 which further drives dispensing valve 30 downwardly against the receiving valve 24.

During the opening portion of the camming sequence stationary disc 32 contacts the underside of valve member 64 driving slidable portion 64 away from first dispensing valve seat 68. Granular material in package 28 is then free to fall through passage 62 into the passages formed by cross shaped tower 34.

During the package removal operation, the package is rotated through opening portion 84 driving dispensing valve 30 upwards away from receiving valve 24. When the lugs of the receiving valve reach the neutral portion of the camming grooves the valves are in the configuration illustrated in Figure 4. Further rotation of dispensing valve 30 relative to receiving valve 24, through the neutral portion of the camming sequence, causes the wiping action between valve member 64 and first dispensing valve seat 68. After the lugs of the receiving valve 24 reach the introduction portion of the camming groove, receiving valve 24 is closed and the package can be removed.

Stationary disc 32 is received in tubular skirt 65 when slidable portion 64 is opened relative to valve seat 68. Therefore, whenever there is chemical flow through the dispensing valve, stationary disc 32 is elevated above valve edge 67 so that chemical granules are free to fall through the receiving valve as the dispensing valve is closing. In addition, as the dispensing valve closes slidable sleeve 36 moves upward allowing granular chemicals in the closed conduit to flow away from the bottom of the sleeve into the hopper. This upward movement of the slidable sleeve facilitates the hopper accepting additional granular chemicals located in the closed conduit when the hopper is full and the package is uncoupled.

It should be noted that lugs 54 and groove 58 can be arranged in a reversed configuration. That is, lugs 54 could be located on inner cup 56 and groove 58 located on outer cup 50.

Receiving valve 24 and dispensing valve 30 are arranged so that the receiving valve is the first

to open and last to close. The overall structure of the valves comprises a sequencing means which ensures that granular material will not be prematurely spilled through the dispensing valve before the receiving valve is opened. Similarly, closing the dispensing valve first, permits granular material trapped between the valves time to flow through the receiving valve into the hopper before the valves are disconnected.

The package can be removed from the hopper while still partially filled with granular material and will be automatically sealed by the operation of the dispensing valve.

A user first aligns the dispensing valve of the chemical package with the receiving valve of the application means.

The user then couples the dispensing valve to the receiving valve. In the present embodiment, the coupling operation comprises rotating the chemical container relative to the receiving valve, however, other coupling methods could be used. The system then automatically opens the receiving valve and the dispensing valve. The opening of the two valves is sequenced so that the receiving valve is automatically opened first.

The system delays the opening of the dispensing valve after the opening of the receiving valve by a predetermined coupling movement. In the embodiment described, the predetermined coupling movement comprises rotating the dispensing valve approximately 69 degrees through the neutral portion of the camming groove. After the granular chemicals have been emptied into the application means, the dispensing valve is uncoupled from the receiving valve. The dispensing valve and the receiving valve are automatically closed during the uncoupling operation. The closing is sequenced so that the dispensing valve is closed first and the receiving valve is closed last. In addition, the closing of the receiving valve is delayed by the predetermined coupling movement so that granular material is allowed to flow from between the valves through the receiving valve and into the hopper. The valve seats of the receiving valve and the dispensing valve are wiped of granules during the delay.

In the preferred embodiment discussed above, the valves automatically open when correctly coupled to one another. However, the opening of the valves could be manually actuated after the valves are coupled to one another.

## Claims

1. An agricultural unit (10) comprising:  
a frame;  
a chemical hopper (18) mounted to the frame  
for holding chemicals to be applied during an

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agricultural operation, the chemical hopper (18) having a lid (22) for enclosing the hopper; application means (20) mounted to the frame for applying the chemicals during an agricultural operation characterized in a chemical metering valve operatively associated with the chemical hopper (18) and the application means (20) for controlling the flow of chemicals from the chemical hopper (18) to the application means (20);  
a receiving valve (24) mounted to the lid (22) of the hopper (18) for receiving the chemicals from a chemical package (28), the receiving valve (24) is biased closed and adapted to receive a cooperating dispensing valve (30) on the chemical package (28).

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2. An agricultural unit (10) as claimed in claim 1 characterized in that the receiving valve (24) comprises a stationary valve disc (32) and a slidable sleeve (36) having a valve seat (40) which contacts the disc (32), the receiving valve (24) is opened by sliding the slidable sleeve (36) away from the valve disc (32) when the dispensing valve (30) is coupled to the receiving valve (24).

15

3. An agricultural unit (10) as claimed in claim 2 characterized in that the stationary valve disc (32) is mounted to a tower (34) that projects upwardly from the hopper (18), the tower (18) being located inside the slidable sleeve (36) and defining passages through which a chemical can flow.

20

4. An agricultural unit (10) as claimed in claim 3 characterized in that the receiving valve (24) is provided with a conical portion (44) and the sliding sleeve (36) is provided with a conical baffle (38) that overlies the conical portion (44).

25

5. An agricultural unit (10) as claimed in claim 4 characterized in that a spring (42) is positioned between the conical portion (44) and the conical baffle (38) for biasing the slidable sleeve (36) upwardly into contact with the stationary valve disc (32).

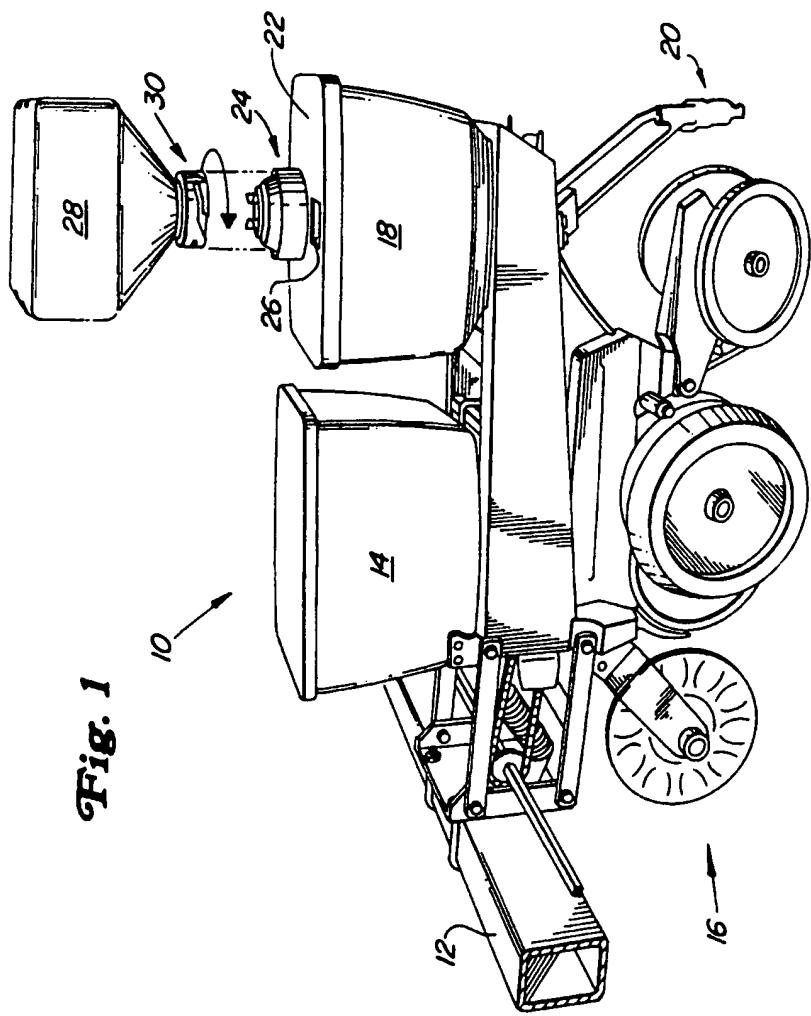
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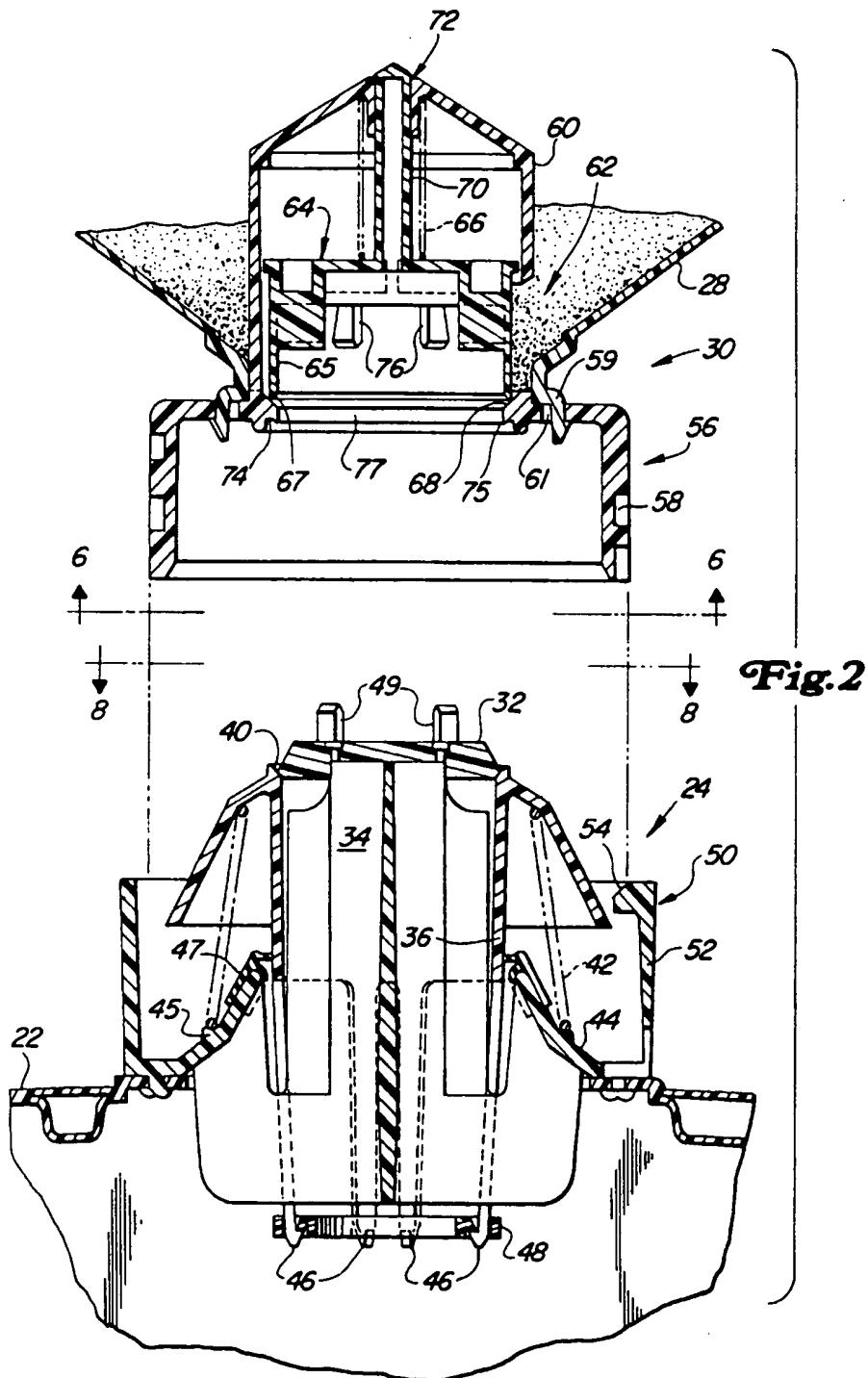
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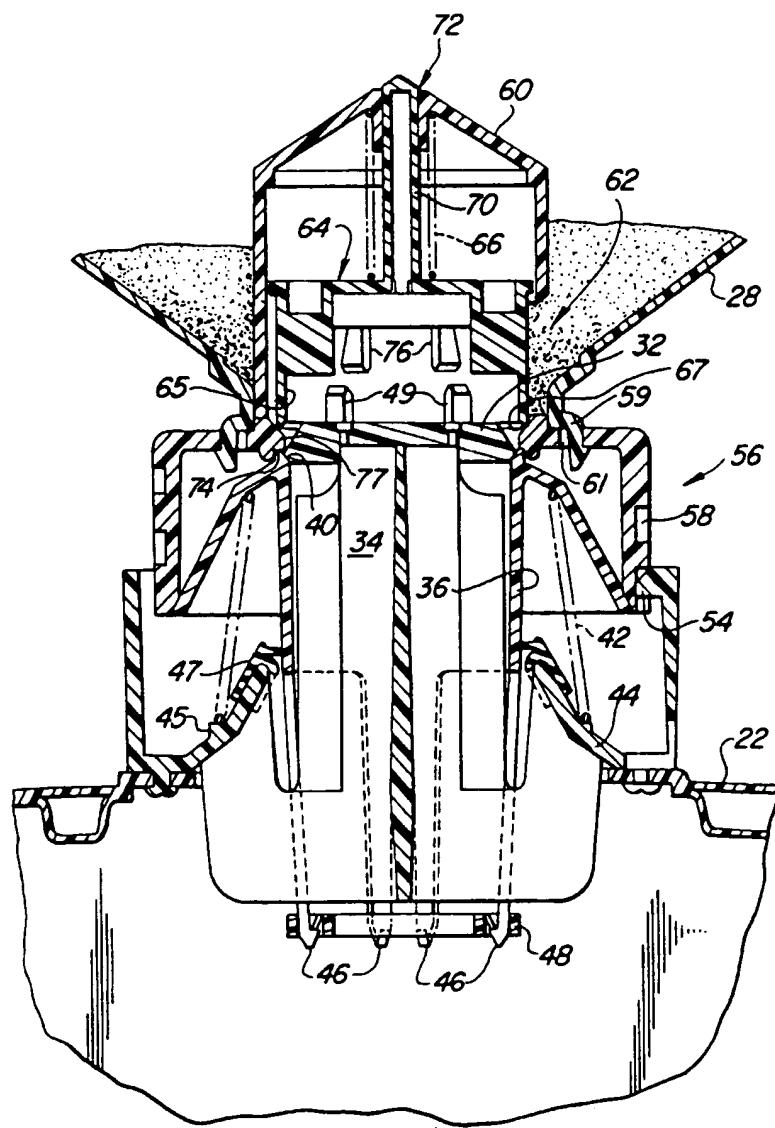
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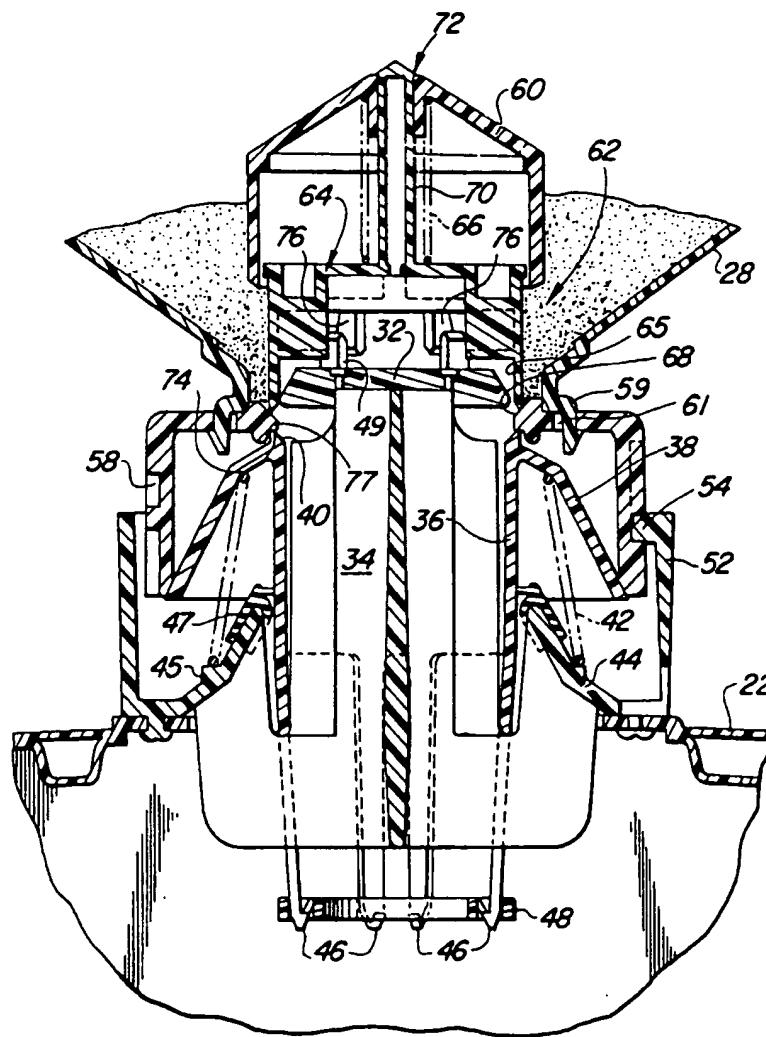
Fig. 1



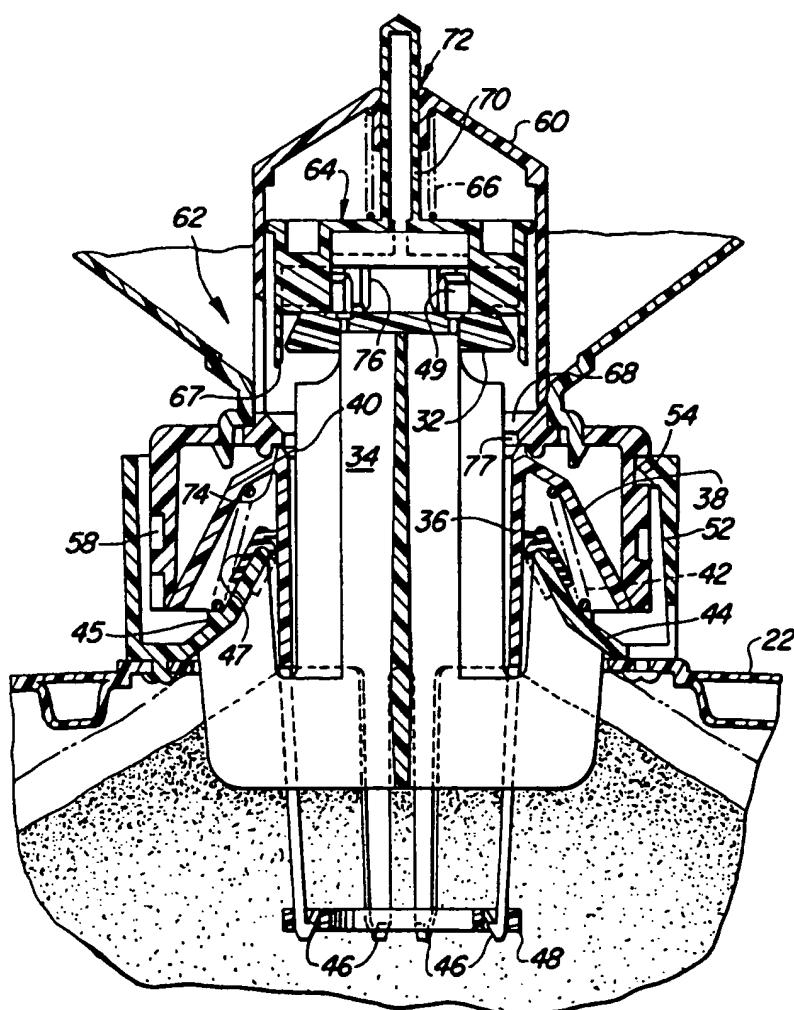




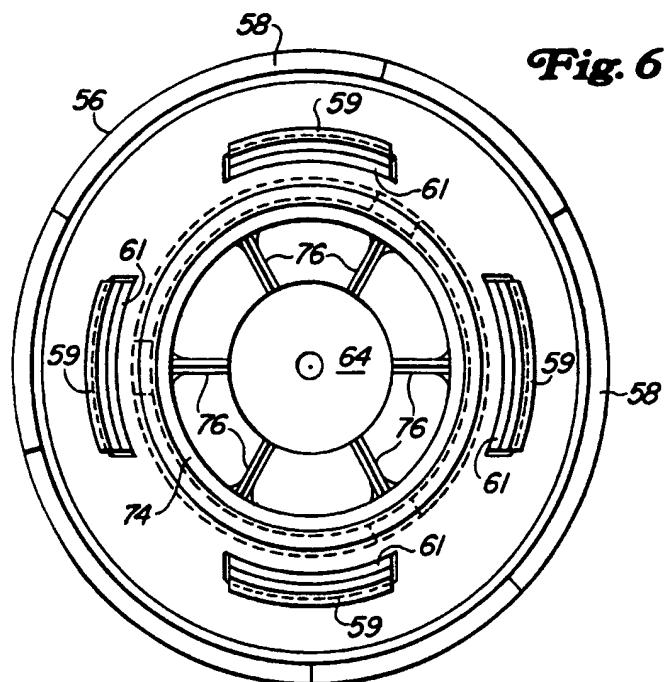
**Fig. 3**



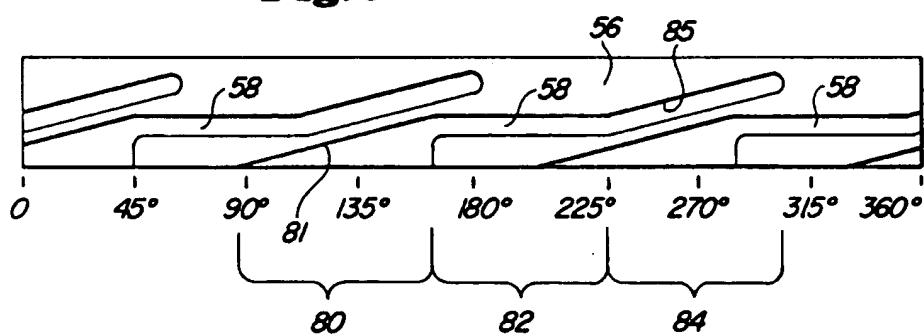
**Fig. 4**



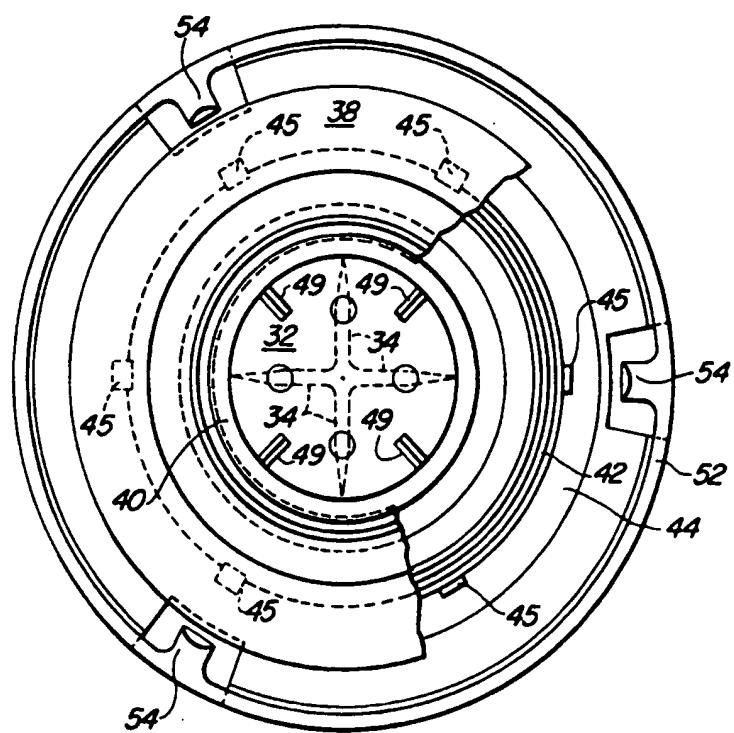
**Fig. 5**

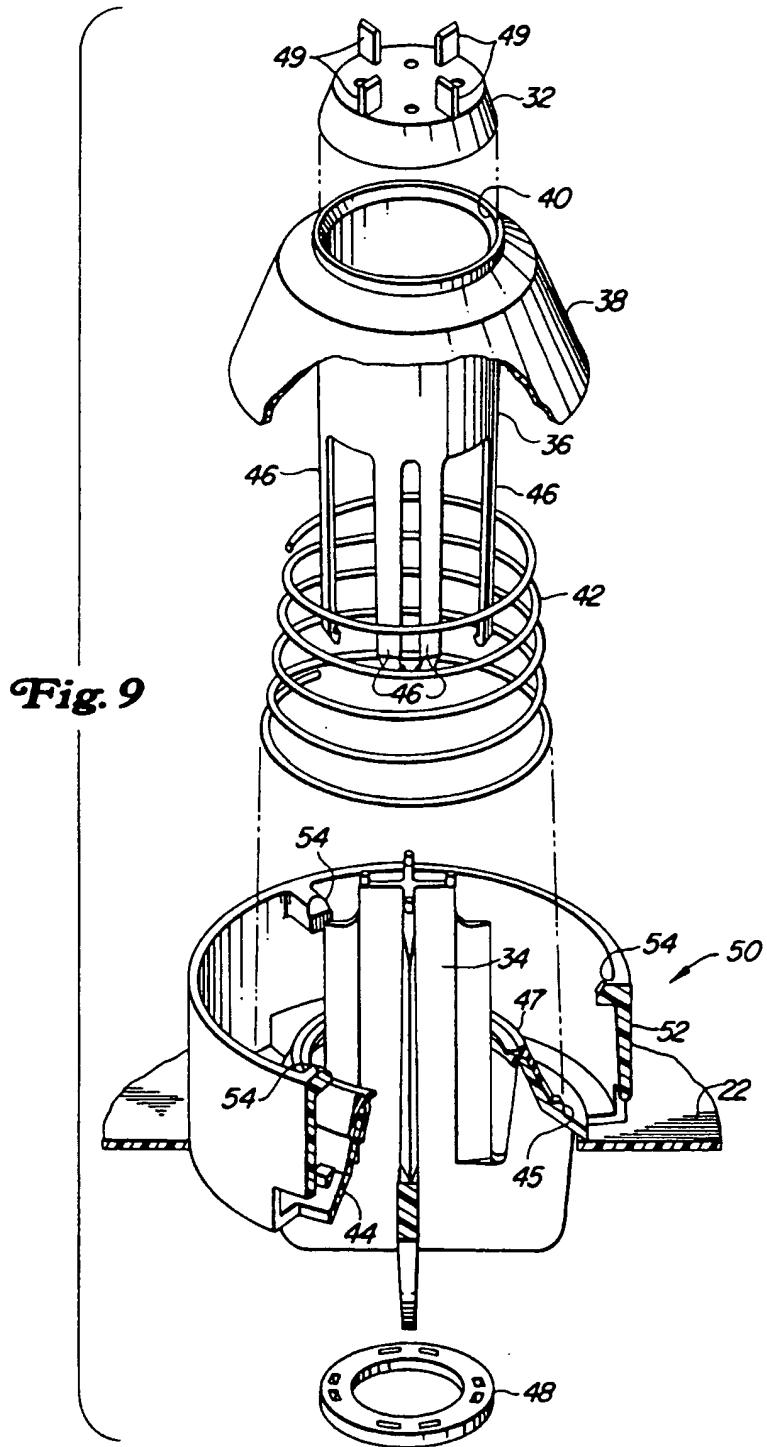


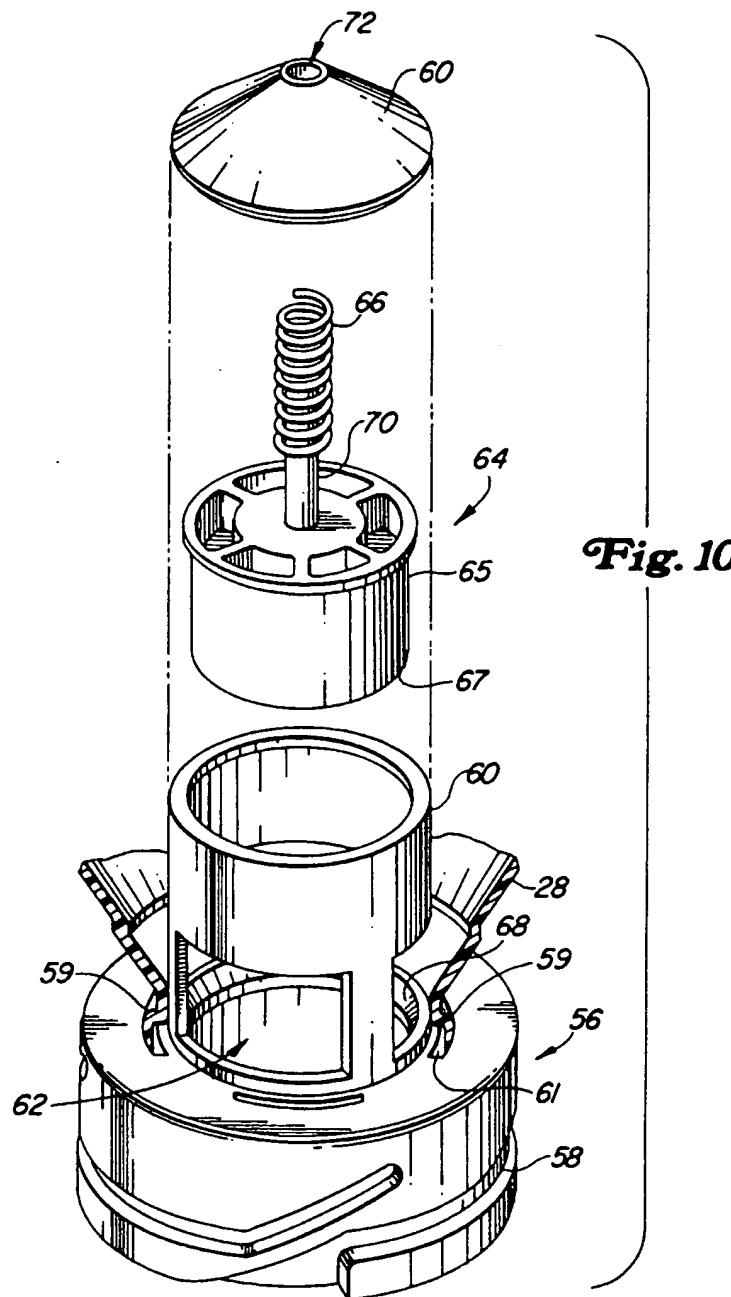
**Fig. 7**



**Fig. 8**







**Fig. 10**